

SPECIAL SECTION

## Grand Challenges in Science Education

### INTRODUCTION

290 Plenty of Challenges for All

### NEWS

292 Transformation Is Possible if a University Really Cares  
>> *Science Podcast*

### REVIEWS

297 The Challenge of Education and Learning in the Developing World  
*M. Kremer et al.*

300 Understanding Neurocognitive Developmental Disorders Can Improve Education For All  
*B. Butterworth and Y. Kovas*

305 Physical and Virtual Laboratories in Science and Engineering Education  
*T. de Jong et al.*  
>> *Science Podcast*

310 Professional Development for Science Teachers  
*S. M. Wilson*

314 Outside the Pipeline: Reimagining Science Education for Nonscientists  
*N. W. Feinstein et al.*  
>> *Science Podcast*

317 Generating Improvement Through Research and Development in Education Systems  
*M. S. Donovan*

320 Proficiency in Science: Assessment Challenges and Opportunities  
*J. W. Pellegrino*

### PERSPECTIVES

309 Teacherpreneurs: A Bold Brand of Teacher Leadership for 21st-Century Teaching and Learning  
*B. Berry*

313 A Business View on U.S. Education  
*R. Stephens and M. Richey*

>> *Editorial p. 249; Education Forums pp. 276 and 278; Science Signaling, Science Careers, and more at [www.sciencemag.org/special/education2013](http://www.sciencemag.org/special/education2013)*

### EDITORIAL

249 Prioritizing Science Education  
*Bruce Alberts*  
>> *Grand Challenges in Science Education section p. 290*

### NEWS OF THE WEEK

254 A roundup of the week's top stories

### NEWS & ANALYSIS

257 Request Would Let Science Rebound From Sequester

258 Wild Cards Remain After Proposed Reshuffle of STEM Education

261 Archaeologists Say the 'Anthropocene' Is Here—But It Began Long Ago

262 Kepler Snags a Super-Earth-Size Planet Squarely in a Habitable Zone  
>> *Science Express Report by W. J. Borucki et al.*

263 Rare Cancer Successes Spawn 'Exceptional' Research Efforts

265 Survey of Peers in Fieldwork Highlights an Unspoken Risk

### NEWS FOCUS

266 Trachea Transplants Test the Limits

269 Chasing Ants—and Robots—to Understand How Societies Evolve  
The Private Lives of Ants  
>> *Science Express Report by D. P. Mersch et al.*

### LETTERS

272 Drought and China's Cave Species  
*S.-S. Shu et al.*

Little Emperors Pose Behavioral Challenges  
*L. Cameron et al.*

Preventing Prejudice in Genome Profiling  
*M. Maruthappu and A. E. Finlayson*

273 CORRECTIONS AND CLARIFICATIONS

273 TECHNICAL COMMENT ABSTRACTS

### BOOKS ET AL.

274 The Earthquake Observers  
*D. R. Coen, reviewed by G. C. Beroza*

275 Edinburgh International Science Festival  
*reviewed by D. Dixon and E. Straughan*  
>> *Science Podcast*

### EDUCATION FORUMS

276 Opportunities and Challenges in Next Generation Standards  
*E. K. Stage et al.*

278 Driven by Diversity  
*J. Ferrini-Mundy*  
>> *Grand Challenges in Science Education section p. 290*

### PERSPECTIVES

279 3D Mapping in the Brain  
*C. Barry and C. F. Doeller*  
>> *Reports pp. 363 and 367*

280 Climate's Dark Forcings  
*M. O. Andreae and V. Ramanathan*

**CONTENTS continued >>**

### ON THE WEB THIS WEEK

>> **Special Issue Video**  
Watch a video about improving education in the developing world at [www.sciencemag.org/special/education2013](http://www.sciencemag.org/special/education2013).

### DEPARTMENTS

247 This Week in *Science*

250 Editors' Choice

252 Science Staff

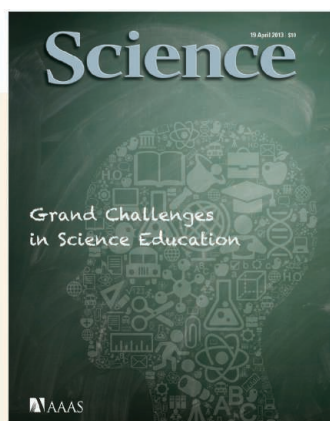
382 New Products

384 Science Careers

### COVER

The 21st-century scientific workforce needs new skills and knowledge to keep pace with ever-changing technology. Larger, more diverse student populations clamor for access to knowledge. All global citizens, whether in a doctor's office or polling booth, must be better informed. All of these needs call for expanded, improved science education. In this special issue, we have invited experts to discuss the most important challenges facing science education. See the special section beginning on page 290.

Images: Thinkstock



- 282 Heterochronic Genes Turn Back the Clock in Old Neurons

*P. Nix and M. Bastiani*

>> Report p. 372

- 283 Polarization Traffic Control for Surface Plasmons

*A. E. Miroshnichenko and Y. S. Kivshar*

>> Reports pp. 328 and 331

- 284 Great Apes and Zoonoses

*P. M. Sharp et al.*

- 286 Pursuing Near-Zero Response

*N. Engheta*

- 287 Fire in the Ocean

*C. A. Masiello and P. Louchouart*

>> Report p. 345

## RESEARCH ARTICLE

- 324 Pervasive Externalities at the Population, Consumption, and Environment Nexus

*P. S. Dasgupta and P. R. Ehrlich*

Challenges posed by the economic consequences of population growth and consumption require collective action.

## REPORTS

- 328 Near-Field Interference for the Unidirectional Excitation of Electromagnetic Guided Modes

*F. J. Rodríguez-Fortuño et al.*

Near-field interference can be used to control the directional propagation of electromagnetic excitations.

- 331 Polarization-Controlled Tunable Directional Coupling of Surface Plasmon Polaritons

*J. Lin et al.*

Control over the generation and propagation direction of light-induced surface plasmons in a thin metal film is demonstrated.

>> Perspective p. 283

- 334 External Quantum Efficiency Above 100% in a Singlet-Exciton-Fission-Based Organic Photovoltaic Cell

*D. N. Congreve et al.*

Single photons are shown to propel more than one carrier in a carbon-based solar cell.

- 337 Multicompartment Mesoporous Silica Nanoparticles with Branched Shapes: An Epitaxial Growth Mechanism

*T. Suteewong et al.*

A one-pot synthesis method furnishes mesoporous silica nanoparticles with both cubic and hexagonally structured compartments.

- 341 Reorganization of Southern Ocean Plankton Ecosystem at the Onset of Antarctic Glaciation

*A. J. P. Houben et al.*

The Southern Ocean plankton ecosystem underwent an abrupt and profound reorganization in the earliest Oligocene.

- 345 Global Charcoal Mobilization from Soils via Dissolution and Riverine Transport to the Oceans

*R. Jaffé et al.*

A larger-than-assumed fraction of charcoal produced by wildfires leaches out of soils and is transported to the oceans.

>> Perspective p. 287

- 347 Resilience and Recovery of Overexploited Marine Populations

*P. Neubauer et al.*

Current fish harvests and low fish levels make fishery recovery improbable for most of the world's depleted stocks.

- 350 A KRAB/KAP1-miRNA Cascade Regulates Erythropoiesis Through Stage-Specific Control of Mitophagy

*I. Barde et al.*

Protein- and RNA-based transcriptional regulation governs the removal of mitochondria during red blood cell differentiation.

- 353 The Helicase-Like Domains of Type III Restriction Enzymes Trigger Long-Range Diffusion Along DNA

*F. W. Schwarz et al.*

A bacterial enzyme that cuts DNA uses a few adenosine triphosphates to allow it to scan across thousands of base pairs.

- 356 Structural Basis for Kinesin-1:Cargo Recognition

*S. Pernigo et al.*

The structure of a portion of a molecular motor complexed to a cargo peptide provides a close-up view of the interaction.

- 359 Actin-Propelled Invasive Membrane Protrusions Promote Fusogenic Protein Engagement During Cell-Cell Fusion

*K. Shilagardi et al.*

An inducible *Drosophila* cell-fusion system reveals the interplay between cellular fusion proteins and actin-driven membrane remodeling.

- 363 Bat and Rat Neurons Differ in Theta-Frequency Resonance Despite Similar Coding of Space

*J. G. Heys et al.*

Stellate cells in the entorhinal cortex of bats and rats show significant differences in their electrophysiological properties.

>> Perspective p. 279

- 367 Representation of Three-Dimensional Space in the Hippocampus of Flying Bats

*M. M. Yartsev and N. Ulanovsky*

The spatial firing properties of neurons were recorded in bats during flight using a wireless neural-telemetry system.

>> Perspective p. 279



page 269



page 274

- 372 Developmental Decline in Neuronal Regeneration by the Progressive Change of Two Intrinsic Timers

*Y. Zou et al.*

Reciprocal signals promote axon regeneration in young worms and repress axon regeneration in older worms.

>> Perspective p. 282

- 376 A Neural Marker of Perceptual Consciousness in Infants

*S. Kouider et al.*

The brain mechanisms underlying conscious perception are already present in infancy and improve with age.

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 2013 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): \$149 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$990; Foreign postage extra: Mexico, Caribbean (surface mail) \$55; other countries (air assist delivery) \$85. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. Printed in the U.S.A.

Change of address: Allow 4 weeks, giving old and new addresses and 8-digit account number. Postmaster: Send change of address to AAAS, P.O. Box 96178, Washington, DC 20090-6178. Single-copy sales: \$10.00 current issue, \$15.00 back issue prepaid includes surface postage; bulk rates on request. Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that \$30.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification code for Science is 0036-8075. Science is indexed in the Reader's Guide to Periodical Literature and in several specialized indexes.

# Science

**340 (6130)**

*Science* **340** (6130), 247-382.

**ARTICLE TOOLS**

<http://science.sciencemag.org/content/340/6130>

**PERMISSIONS**

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

---

*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. The title *Science* is a registered trademark of AAAS.

Copyright © 2013 The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works.